Eclipse II and miniEclipse OEM Boards

Integrators Guide

Part No. 875-0275-000 Rev. A1

Hemisphere GPS

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(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

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Hemisphere GPS Precision GPS Applications

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6,111,549	6,397,147	6,469,663	6,501,346	6,539,303
6,549,091	6,631,916	6,711,501	6,744,404	6,865,465
6,876,920	7,142,956	7,162,348	7,277,792	7,292,185
7,292,186	7,373,231	7,400,956	7,400,294	7,388,539
7,429,952	7,437,230	7,460,942		

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Chapter 1: Introducing the Eclipse OEM Board

Eclipse OEM Board Options

Eclipse OEM Board Integration

Common Features of All Eclipse OEM Boards

What's Included

Eclipse OEM Board Options

The Eclipse OEM board is available in two form factors:

- Eclipse™ II OEM board (model P320™)
- miniEclipse™ OEM board (models P200™ and P201™)

Note: This manual cover both OEM board form factors: the Eclipse™ II OEM board and the miniEclipse™ OEM board. When referring to both boards this manual uses the term Eclipse OEM board. When referring to one board or the other this manual uses the name of the specific board (Eclipse II OEM board or miniEclipse OEM board).

Note: This manual does not cover in any detail receiver operation, the PocketMAX utility, nor commands and messages (NMEA 0183, 2000 or HGPS proprietary messages). For information on these subjects refer to Hemisphere GPS' GPS Technical Reference available at www.hemispheregps.com.

Eclipse OEM Board Integration

Successful integration of the Eclipse OEM board within a system requires electronics expertise that includes:

- Power supply design
- Serial port level translation
- Reasonable radio frequency competency
- An understanding of electromagnetic compatibility
- Circuit design and layout

The Eclipse GPS engine is a low-level module intended for custom integration with the following general integration requirements:

- Regulated power supply input (3.3 VDC ± 3%) and 300 mA continuous
- Low-level serial port (3.3 V CMOS) and USB port communications
- Radio frequency (RF) input to the engine from a GPS antenna is required to be actively amplified (10 to 40 dB gain)
- GPS antenna is powered with a separate regulated voltage source up to 15 VDC maximum
- Antenna input impedance is 50 Ω

Common Features of All Eclipse OEM Boards

Common features of the Eclipse II and miniEclipse OEM boards include:

- 12-channel GPS engine (2 channels dedicated to SBAS tracking)
- Sub-meter horizontal accuracy 95%
- Raw measurement output (via documented binary messages)
- Position and heading update rates of 20 Hz max
- COAST™ technology that provides consistent performance with correction data
- e-Dif®-ready - a base station-free way of differentially positioning

- L-Dif™ -ready – Local differential is a proprietary Hemisphere GPS method where a specialized set of messages are relayed between two Eclipse receivers
- Quick times to first fix
- Three full-duplex serial ports, a dedicated RTCM input port, and a USB port
- 1 PPS timing output
- Event marker input
- Compact form factor

Note: For complete specifications of the Eclipse II OEM board and miniEclipse OEM board see Appendix C, "Specifications."

What's Included

The Eclipse OEM board is available in two configurations:

- Eclipse OEM board only - designed for integrators who are familiar with Eclipse board integration
- Eclipse OEM board development kit - designed for integrators who are new to Eclipse board integration and includes the following parts in addition to the Eclipse OEM board:
  - Enclosure with carrier board
  - Antenna with mounting hardware
  - Associated cables

  See Chapter 4, "Eclipse OEM Board Development Kit" for more information on the development kit.

Chapter 2: Eclipse OEM Board Overview

Eclipse II OEM Board Key Features

miniEclipse OEM Board Key Features

Eclipse OEM Board Mechanical Layout

Connectors

Mounting Options

Eclipse OEM Board Headers

Signals

Shielding

Receiver Mounting

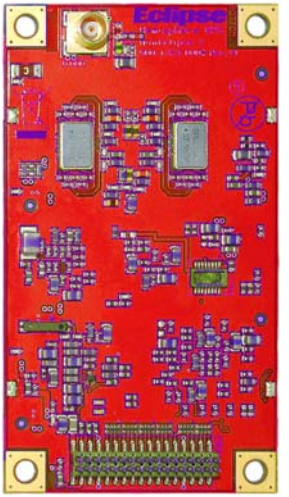
Thermal Concerns

Eclipse II OEM Board Key Features

The Eclipse II OEM board offers low power consumption, fast output rates of up to 20 Hz, and OmniSTAR® support. Offering full scalability and expandability from L1 GPS through L1/L2 GNSS and combined with advanced multipath mitigation techniques, this feature-rich multi-frequency GNSS board is a cost-effective, multi-GNSS solution compatible with other GNSS products.

Improved RTK performance based on Hemisphere GPS' patent-pending SureTrack® technology is scalable with Eclipse II, allowing you to achieve centimeter-level accuracy with L1/L2 GPS or improve performance and reliability with L1/L2 GLONASS signals. SureTrack ensures that the RTK rover receiver makes use of every satellite it is tracking, even satellites not tracked at the base. Additional benefits include fewer RTK dropouts in congested environments, faster requisitions and more robust solutions due to better cycle slip detection, and the ability to process GNSS data from various manufacturers. Even if the base supports only GPS, SureTrack processes GLONASS signals at the rover to deliver complete GNSS performance.

miniEclipse OEM Board Key Features



Measuring 41 mm x 71 mm in size, the low power consumption and simple on-board firmware of miniEclipse make it an ideal solution, offering scalability and expandability from L1 GPS with SBAS to L1/L2 GPS with RTK.

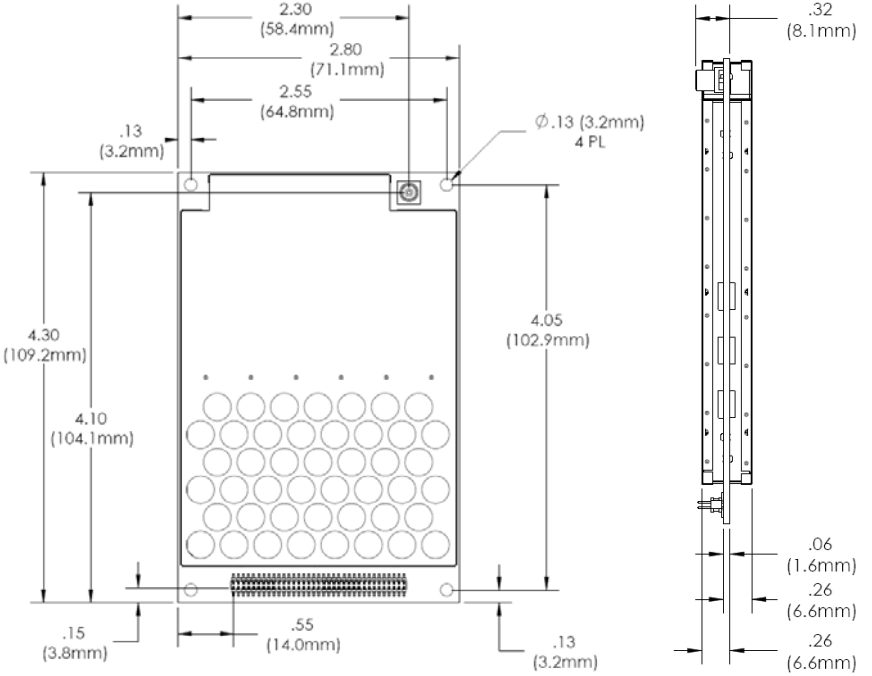
miniEclipse receivers are offered in two common industry form factors: P200 and P201. P200 is a drop-in replacement for Hemisphere GPS' Crescent® receiver, while P201 has a mechanical design compatible with popular aftermarket products. The reliable positioning performance of miniEclipse is further enhanced through Eclipse RTK and COAST DGPS technology.

With miniEclipse, RTK performance is scalable. Utilize the same centimeter-level accuracy in either L1-only mode, or employ the full performance of fast RTK performance over long distances with L1/L2 GPS signals. Hemisphere GPS' exclusive SureTrack technology provides peace of mind knowing the RTK rover is making use of every satellite it is tracking, even satellites not tracked at the base. Benefit from fewer RTK dropouts in congested environments, faster reaquisitions, and more robust solutions due to better cycle slip detection.

Patented COAST software enables select Hemisphere GPS receivers to utilize previous DGPS correction data during times of interference, signal blockage, and weak signal. The receiver will coast and continue to maintain sub-meter positioning for up to 40 minutes without a DGPS signal.

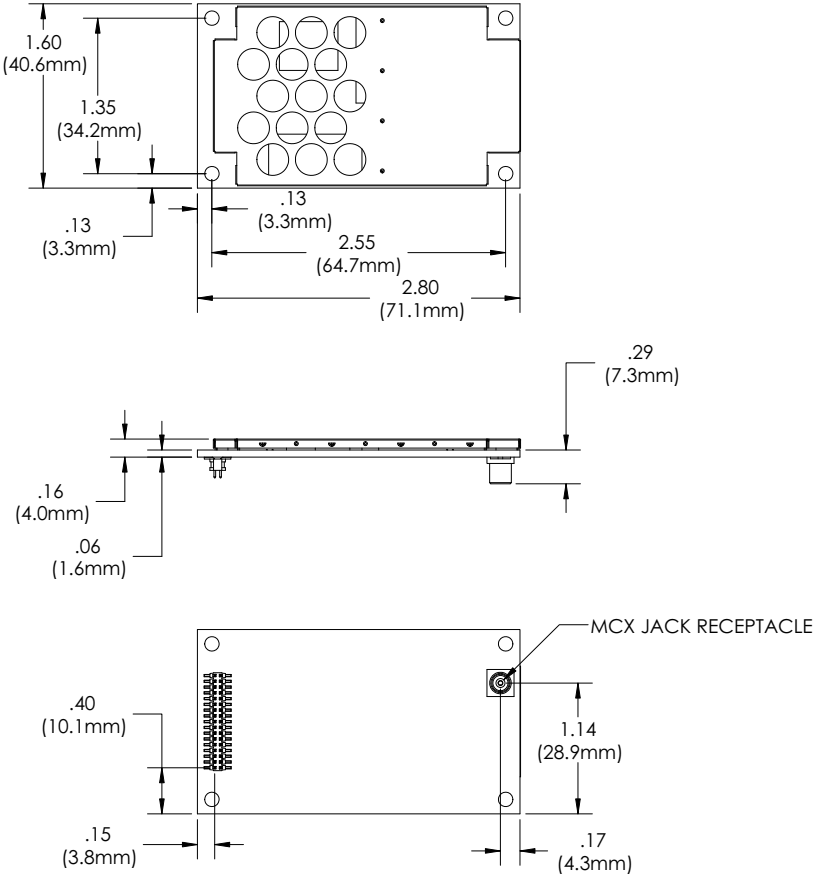
Eclipse OEM Board Mechanical Layout

Figure 2-1 shows the mechanical layout for the Eclipse II P320 OEM board, Figure 2-2 shows the mechanical layout for the miniEclipse P200 OEM board, and Figure 2-3 shows the mechanical layout for the miniEclipse P201 OEM board.



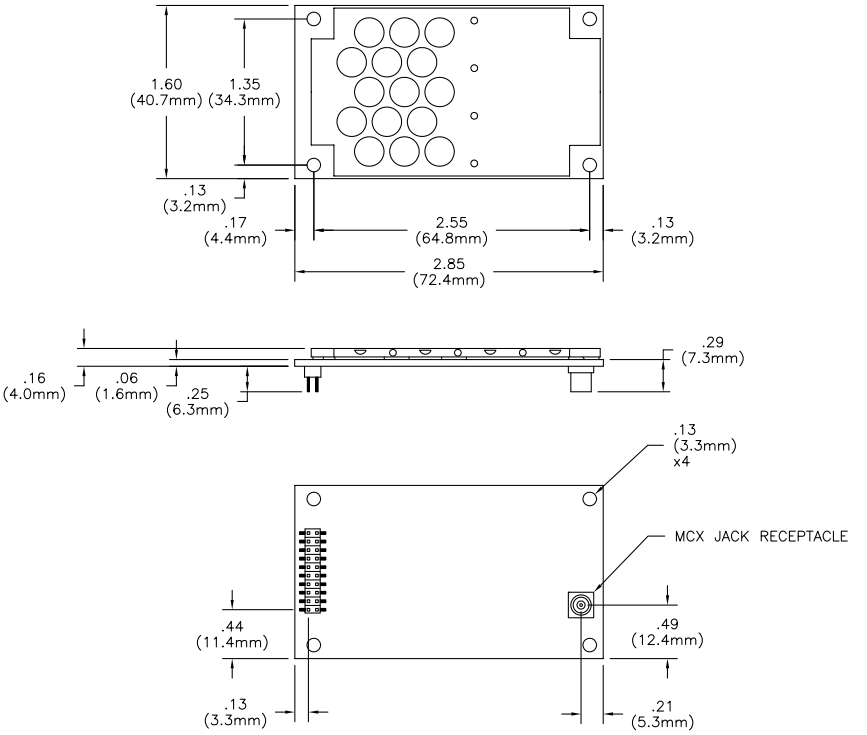
Dimensions are in inches (millimeters)

Figure 2-1: Eclipse II OEM board top and side views



Dimensions are in inches (millimeters)

Figure 2-2: miniEclipse P200 OEM board top, side, and side views



Dimensions are in inches (millimeters)

Figure 2-3: miniEclipse P201 OEM board top, side, and side views

Connectors

Table 2-1 describes the Eclipse OEM board's connectors and the mating connectors. You can use different compatible connectors; however, the requirements may be different. The antenna input impedance is 50 Ω.

Table 2-1: Eclipse OEM board connectors

Connector	Eclipse OEM Board SMT Connector	Mating Connector
RF	MCX, straight jack (female) Johnson 133-3711-202	MCX, Straight plug (male) Samtec: RSP-127824-01
Interface	35 x 2 pin header plug (male) 0.05 inch 0.05 in (1.27 mm) pitch Samtec: FTSH-135-01-L-DV	35 x 2, SMT header socket (female) 0.05 in (1.27 mm) pitch Samtec: FLE-135-01-G-DV

Mounting Options

There are two options for mounting the Eclipse OEM board:

- Direct Electrical Connection method
- Indirect Electrical Connection (Cable) method

Direct Electrical Connection Method

Place an RF connector, heading connector, and mounting holes on the carrier board and then mount the Eclipse OEM board on the standoffs and RF header connectors. This method is very cost effective as it does not use cable assemblies to interface the Eclipse OEM board to the integrator.

Note: Be aware of the GPS RF signals present on the carrier board and ensure the correct stand-off height to avoid any flexual stresses on the board when you fasten it down.

The Eclipse OEM board uses a standoff height of 0.79 cm (0.3125 in). With this height there should be no washers between either the standoff and the Eclipse OEM board or the standoff and the carrier board; otherwise, you must make accommodations. You may need to change the standoff height if you select a different header connector.

If you want to use a right angle MCX connector, use a taller header than the Samtec part number that Hemisphere GPS suggests. This will provide clearance to have a right angle cable-mount connector and reduce the complexity by not having the carrier board handle the RF signals. See Table 2-1 on page 11 for Eclipse OEM board connector information.

The mounting holes of the Eclipse OEM boards have a standard inner diameter of 0.32 cm (0.125 in).

Indirect Electrical Connection (Cable) Method

The second method is to mount the Eclipse OEM board mechanically so you can connect a ribbon power/data cable to the Eclipse OEM boards. This requires cable assemblies and there is a reliability factor present with cable assemblies in addition to increased expense.

Eclipse OEM Board Headers

The Eclipse OEM boards use a dual-row header connector to interface with power, communications, and other signals.

To identify the first header pin orient the board so the diamond is to the upper left of the pins; the first pin is on the left directly below the diamond. The pins are then sequentially numbered per row from top to bottom.

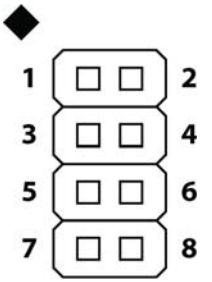


Figure 2-4: Identifying the first pin on the header connector

Eclipse II OEM Board Header Pinout Descriptions

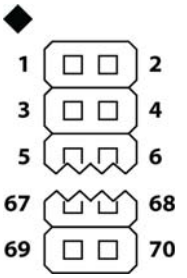


Figure 2-5: Eclipse II OEM board (P320) header layout

Table 2-2 provides pinout details for the Eclipse II OEM board (P320) header.

Table 2-2: Eclipse II OEM board (P320) header pinout descriptions

Pin	Name	Type	Description
1	3.3 V	Power	Receiver power supply, 3.3 V
2	3.3 V	Power	Receiver power supply, 3.3 V
3	3.3 V	Power	Receiver power supply, 3.3 V
4	3.3 V	Power	Receiver power supply, 3.3 V
5	GND	Power	Receiver ground
6	GND	Power	Receiver ground
7	Antenna Pwr	Power	Antenna power, DC, 15 V max
8	Batt Backup	Power	Power, 2.7 to 4.5 V, 500 nA typical
9	n/c	n/c	n/c
10	n/c	n/c	n/c
11	n/c	n/c	n/c
12	Reset	Open collector	Reset, open collector, 3.3 V typical, not required
13	GND	Power	Receiver ground

Table 2-2: Eclipse II OEM board (P320) header pinout descriptions

Pin	Name	Type	Description
14	GND	Power	Receiver ground
15	n/c	n/c	n/c
16	USB-DVBS	Input	Device USB bus power monitor
17	Manual Mark	Input	Active low, falling edge, 3.3 V CMOS
18	1 PPS	Output	Active low, falling edge, 3.3 V CMOS
19	Speed Output	Output	0 - 3 V variable clock output
20	Speed Ready	Output	Active low, speed valid indicator, 3.3 V CMOS
21	n/c	n/c	n/c
22	USB-PSW (reserved)	Input	Reserved for possible future USB OTG
23	GND	Power	Receiver ground
24	USB-HVBS	Input	Host USB bus power monitor
25	PATX	Output	Port A serial output, 3.3 V CMOS, idle high
26	PARX	Input	Port A serial input, 3.3 V CMOS, idle high
27	PBTX	Output	Port B serial output, 3.3 V CMOS, idle high
28	PBRX	Input	Port B serial input, 3.3 V CMOS, idle high
29	PCTX	Output	Port C serial output, 3.3 V CMOS, idle high
30	PCRX	Input	Port C serial input, 3.3 V CMOS, idle high
31	PDTX	Output	Port D serial output, 3.3 V CMOS, idle high
32	PDRX	Input	Port D serial input, 3.3 V CMOS, idle high
33	n/c	n/c	n/c
34	n/c	n/c	n/c
35	GND	Power	Receiver ground

Table 2-2: Eclipse II OEM board (P320) header pinout descriptions

Pin	Name	Type	Description
36	GND	Power	Receiver ground
37	USB HOST+	I/O	USB host data +
38	USB DEV+	I/O	USB device data +
39	USB HOST–	I/O	USB host data -
40	USB DEV–	I/O	USB device data -
41	GND	Power	Receiver ground
42	n/c	n/c	n/c
43	n/c	n/c	n/c
44	n/c	n/c	n/c
45	n/c	n/c	n/c
46	GND	Power	Receiver ground
47	n/c	n/c	n/c
48	n/c	n/c	n/c
49	n/c	n/c	n/c
50	n/c	n/c	n/c
51	GND	Power	Receiver ground
52	n/c	n/c	n/c
53	n/c	n/c	n/c
54	n/c	n/c	n/c
55	n/c	n/c	n/c
56	n/c	n/c	n/c
57	GPS Lock	Output	Status indicator, 3.3 V CMOS, active low
58	n/c	n/c	n/c

Table 2-2: Eclipse II OEM board (P320) header pinout descriptions

Pin	Name	Type	Description
59	Diff Lock	Output	Status indicator, 3.3 V CMOS, active low
60	n/c	n/c	n/c
61	DGPS Lock	Output	Status indicator, 3.3 V CMOS, active low
62	n/c	n/c	n/c
63	GND	Power	Receiver ground
64	GND	Power	Receiver ground
65	Analog GND	Power	Receiver ground
66	n/c	n/c	n/c
67	n/c	n/c	n/c
68	Analog GND	Power	Receiver ground
69	Analog GND	Power	Receiver ground
70	n/c	n/c	n/c

Note:

- Pins are not 5 V tolerant. The pin voltage range is 0 to 3.3 VDC, unless otherwise noted.
- Leave any data or I/O pins that will not be used unconnected.

miniEclipse OEM Board (P200) Header Pinout Descriptions

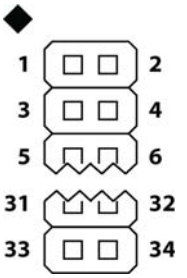


Figure 2-6: miniEclipse OEM board (P200) header layout

Table 2-3 provides pinout details for the miniEclipse OEM board (P200) header.

Table 2-3: miniEclipse OEM board (P200) header pinout descriptions

Pin	Name	Type	Description
1	3.3 V	Power	Receiver power supply, 3.3 V
2	3.3 V	Power	Receiver power supply, 3.3 V
3	Antenna Power	Output	Antenna power, DC, 15 V max
4	Battery backup	Input	Power, 1.5 to 5.5 V, 500 nA typical
5	USB DEV+	I/O	USB device data +
6	USB DEV–	I/O	USB device data -
7	GND	Power	Receiver ground
8	GND	Power	Receiver ground
9	PATX	Output	Port A serial output, 3.3 V CMOS, idle high
10	PARX	Input	Port A serial input, 3.3 V CMOS, idle high
11	PBTX	Output	Port B serial output, 3.3 V CMOS, idle high
12	PBRX	Input	Port B serial input, 3.3 V CMOS, idle high

Table 2-3: miniEclipse OEM board (P200) header pinout descriptions

Pin	Name	Type	Description
13	PDTX	Output	Port D serial output, 3.3 V CMOS, idle high
14	PDRX	Input	Port D serial input, 3.3 V CMOS, idle high
15	1 PPS	Output	Active low, falling edge, 3.3 V CMOS
16	Manual Mark	Input	Active low, falling edge, 3.3 V CMOS
17	GPS Lock	Output	Status indicator, 3.3 V CMOS, active low
18	Diff Lock	Output	Status indicator, 3.3 V CMOS, active low
19	DGPS Lock	Output	Status indicator, 3.3 V CMOS, active low
20	n/c	n/c	n/c
21	GPIO0	I/O	General purpose input/output
22	GPIO1	I/O	General purpose input/output
23	GPIO2	I/O	General purpose input/output
24	GPIO3	I/O	General purpose input/output
25	Speed Output	Output	0 - 3 V variable clock output
26	Speed Ready	Output	Active low, speed valid indicator, 3.3 V CMOS
27	GND	Power	Receiver ground
28	GND	Power	Receiver ground
29	n/c	n/c	n/c
30	n/c	n/c	n/c
31	PCTX	Output	Port C serial output, 3.3 V CMOS, idle high
32	PCRX	Input	Port C serial input, 3.3 V CMOS, idle high
33	L-Band Enable	Output	Reserved
34	Reset	Open collector	Reset, open collector, 3.3 V typical, not required

Note:

- Pins are not 5 V tolerant. The pin voltage range is 0 to 3.3 VDC, unless otherwise noted.
- Leave any data or I/O pins that will not be used unconnected.

miniEclipse OEM Board (P201) Header Pinout Descriptions

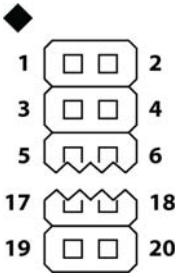


Figure 2-7: miniEclipse OEM board (P201) header layout

Table 2-4 provides pinout details for the miniEclipse OEM board (P201) header.

Table 2-4: miniEclipse OEM board (P201) header pinout descriptions

Pin	Name	Type	Description
1	Antenna Power	Output	Antenna power, DC, 15 V max
2	3.3 V	Power	Receiver power supply, 3.3 V
3	USB DEV–	I/O	USB device data -
4	USB DEV+	I/O	USB device data +
5	Reset	Open collector	Reset, open collector, 3.3 V typical, not required
6	PCRX	Input	Port C serial input, 3.3 V CMOS, idle high
7	PCTX	Output	Port C serial output, 3.3 V CMOS, idle high
8	PDRX	Input	Port D serial input, 3.3 V CMOS, idle high
9	PDTX	Output	Port D serial output, 3.3 V CMOS, idle high
10	GND	Power	Receiver ground
11	PATX	Output	Port A serial output, 3.3 V CMOS, idle high
12	PARX	Input	Port A serial input, 3.3 V CMOS, idle high

Table 2-4: miniEclipse OEM board (P201) header pinout descriptions

Pin	Name	Type	Description
13	GND	Power	Receiver ground
14	PBTX	Output	Port B serial output, 3.3 V CMOS, idle high
15	PBRX	Input	Port B serial input, 3.3 V CMOS, idle high
16	GND	Power	Receiver ground
17	Manual Mark	Input	Active low, falling edge, 3.3 V CMOS
18	GND	Power	Receiver ground
19	1 PPS	Output	Active low, falling edge, 3.3 V CMOS
20	Position Valid Indicator	Output	Status indicator, 3.3 V CMOS, active low

Note:

- Pins are not 5 V tolerant. The pin voltage range is 0 to 3.3 VDC, unless otherwise noted.
- Leave any data or I/O pins that will not be used unconnected.

Signals

This section provides more detail on the signals available via connectors.

RF Input

The Eclipse OEM boards are designed to work with active GPS antennas with an LNA gain range of 10 to 40 dB. The purpose of the range is to accommodate for losses in the cable system. Essentially, there is a maximum cable loss budget of 30 dB for a 40 dB gain antenna. Depending on the chosen antenna, the loss budget will likely be lower (a 24 dB gain antenna would have a 14 dB loss budget).

When designing the internal and external cable assemblies and choosing the RF connectors, do not exceed the loss budget; otherwise, the tracking performance of the Eclipse OEM board will be compromised.

Serial Ports

The Eclipse OEM board has four serial communication ports:

- Port A, Port B, Port C - main ports
- Port D - Exclusively used to interface with the SBX beacon board or an external corrections source. This port will not output normal GPS-related NMEA messages. When communicating into either Port A, B, or C, a virtual connection may be established to the device on Port D using the $JCONN command. See “Communication Port D” below for more information on Port D.

The Eclipse OEM board serial ports’ 3.3 V CMOS signal level can be translated to interface to other devices. For example, if serial Ports A, B, and/or C are used to communicate to external devices such as PCs, you must translate the signal level from 3.3 V CMOS to RS-232.

Communication Port D

Port D is exclusively for external DGPS correction input to the Eclipse OEM board, such as from Hemisphere GPS’ SBX beacon board.

USB Ports

The Eclipse II OEM board has USB device and host ports and the miniEclipse OEM board has just the USB device port (no USB host port), where:

- USB Device port (data communication) shown in Figure 2-8 on page 25 serves as a high speed data communications port, for something such as a PC
- USB Host port (data storage) shown in Figure 2-9 on page 26 serves as a data storage port (such as with a USB flash drive)

The USB data lines are bi-directional and are differential pairs. The USB data lines should be laid out on Printed Wire Board (PWB) with 45 Ω characteristic impedance and 90 Ω differential impedance. Treat he data lines as if they are RF signals.

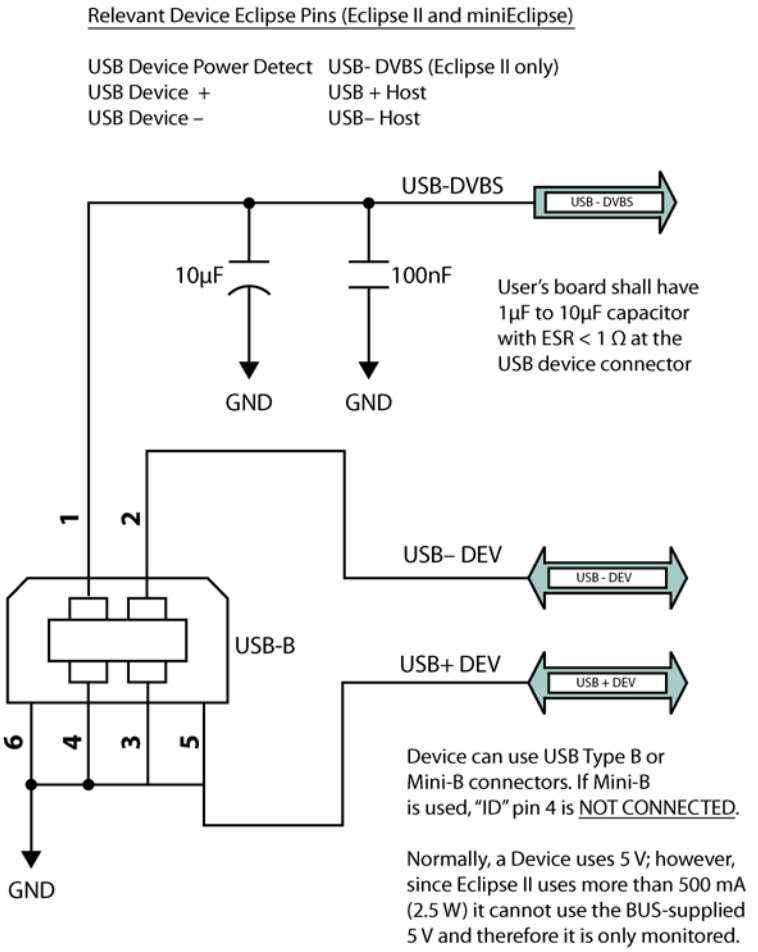

Relevant Device Eclipse Pins (Eclipse II and miniEclipse)
USB Device Power Detect
USB Device +
USB Device –
USB- DVBS (Eclipse II only)
USB + Host
USB– Host
USB-DVBS
USB - DVBS
10µF
100nF
User's board shall have 1µF to 10µF capacitor with ESR < 1 Ω at the USB device connector
GND
GND
1
2
USB– DEV
USB - DEV
USB-B
USB+ DEV
USB + DEV
6
4
3
5
Device can use USB Type B or Mini-B connectors. If Mini-B is used, "ID" pin 4 is NOT CONNECTED.
Normally, a Device uses 5 V; however, since Eclipse II uses more than 500 mA (2.5 W) it cannot use the BUS-supplied 5 V and therefore it is only monitored.
GND

Figure 2-8: Eclipse OEM board USB device design example

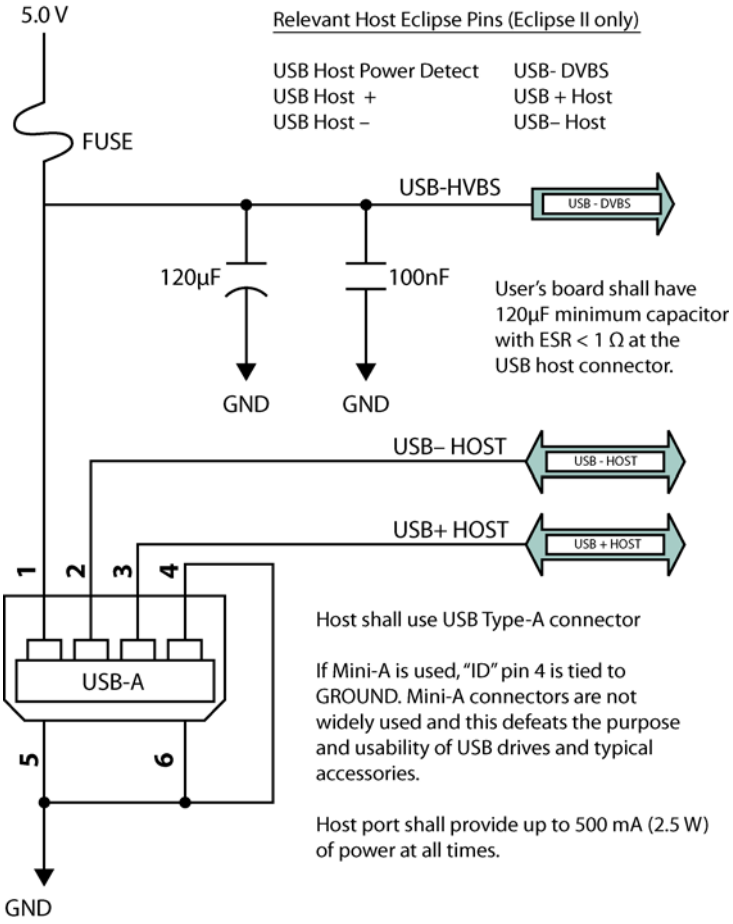


Figure 2-9: Eclipse OEM board USB host design example

LED Indicators

The Eclipse OEM board includes the following SMT LEDs:

- PWR - Power
- GPS - GPS lock
- DIFF - Differential lock
- DGPS - DGPS position
- L-BAND - L-band lock

With the exception of the power LED the signals that drive the LEDs are available via the header connector. Refer to Table 2-2 through Table 2-4 for pin number descriptions for Eclipse OEM boards.

Note: Each signal pin can offer only 1 mA of current and is active low. Since 1 mA of current may be inadequate for the application, you may want to transistor-buffer these signals to provide more current capacity for acceptable LED luminance.

1PPS Timing Signal

The one pulse per second (1 PPS) timing signal is used in applications where devices require time synchronization.

Note: 1 PPS is typical of most GPS boards but not essential to normal receiver operation. Do not connect the pin if you do not need this function.

The 1 PPS signal is 3.3 V HCMOS, normally low with rising edge synchronization. The 1 PPS signal is capable of driving a load impendance greater than 10 kΩ in parallel with 10 pF. The pulse is approximately 1 ms.

Event Marker Input

A GPS solution may need to be forced at a particular instance, not synchronized with GPS time depending on the application, such as

indicating to the GPS receiver when a photo is taken from a camera used for aerial photography.

Note: This feature is typical of most GPS boards but is not essential to normal receiver operation. Do not connect the pin if there is no need for this function.

The event marker input is active low 3.3 V HCMOS with falling edge synchronization. The input impedance and capacitance is higher than 10 kOhms and 10 pF respectively, with a threshold of lower than 0.7 V required to recognize the input.

Grounds

You must connect all grounds together when connecting the ground pins of the Eclipse OEM board. These are not separate analog and digital grounds that require separate attention. Refer to Table 2-2 through Table 2-4 for pinout ground information for Eclipse OEM boards.

Speed Radar Output

The following two pins on the Eclipse OEM board relate to the Speed Radar.

- Speed Radar Pulse - Outputs a square wave with 50% duty cycle. The frequency of the square wave varies directly with speed. 97 Hz represents a speed of 1 m/s (3.28 ft/s).
- Speed Radar Ready Signal - Indicates when the speed signal on the “Speed Radar Pulse” pin is valid. In static situations, such as when the vehicle has stopped, the GPS position may still have slight variations from one moment to the next. During these instances, the signal on the “Speed Radar Ready Signal” pin is "high" or +Vcc, indicating the speed coming out of the “Speed Radar Pulse” pin is erroneous and not truly indicative of the GPS receiver’s actual speed. **Therefore, it should not be referred to or be used.** Once the vehicle starts moving again and meets a minimum threshold speed, the output on the “Speed Radar Ready Signal” pin

will go "low" indicating valid speed information is present on the “Speed Radar Pulse” pin.

Table 2-5 provides the location of the Speed Radar Pulse and Speed Radar Ready Signal on the Eclipse OEM boards.

Table 2-5: Speed radar output availability on Eclipse OEM boards

Eclipse OEM Board	Speed Radar Pulse	Speed Radar Ready Signal
Eclipse II (P320)	Pin 19	Pin 20
mini Eclipse (P200)	Pin 25	Pin 26
mini Eclipse (P201)	N/A	N/A

Note: Neither pin (19 or 20 for P320, 25 or 26 for P200) has any form of isolation or surge protection. If utilizing the Speed Radar Pulse output, Hemisphere GPS strongly recommends incorporating some form of isolation circuitry into the supporting hardware. Contact Hemisphere GPS Customer Support for an example of an optically isolated circuit.

Note: This feature is not essential to normal receiver operation. Do not connect the pins if there is no need for this function.

Shielding

The Eclipse OEM board is a sensitive instrument. When integrated into an enclosure, the Eclipse OEM board requires shielding from other electronics to ensure optimal operation. The Eclipse OEM board shield design consists of a thin piece of metal with specific diameter holes, preventing harmful interference from penetrating, while still allowing air circulation for cooling.

Receiver Mounting

The Eclipse OEM board is a precision instrument. To ensure optimal operation, consider mounting the receiver in a way to minimize vibration and shock.

When mounting the Eclipse OEM board immediately adjacent to the GPS antenna, Hemisphere GPS highly recommends shielding the board from the LNA of the antenna. This step can be more complex than some integrators initially estimate. Attempt to confirm the operation in your application as early in the project as possible.

Thermal Concerns

The Eclipse OEM board receiver consumes a few watts of power which ultimately will generate heat. Since this may raise the ambient temperature inside of an enclosure consider managing the heat inside the enclosure to ensure the internal temperature does not exceed the maximum operating temperature for the Eclipse OEM board. Some suggestions for heat management are heat sinks, heat conductive foam, or using a small cooling fan possibly using a thermal switch. Air moving over the Eclipse OEM board removes heat very effectively.

Note: Thermal design may only be a concern if the integrated product's maximum design temperature is expected to be close to that of the Eclipse OEM board.

Chapter 3: Eclipse OEM Board Operation

Powering the Eclipse OEM Board

Communicating with the Eclipse OEM Board

Configuring the Eclipse OEM Board Firmware

Configuring the Data Message Output

Saving the Eclipse OEM Board Configuration

Using Port D for RTCM Input

Powering the Eclipse OEM Board

The Eclipse OEM board is powered by a 3.3 VDC power source. Once you connect appropriate power the Eclipse OEM board is active. Although the Eclipse OEM board proceeds through an internal startup sequence upon application of power, it is ready to communicate immediately.

Install the antenna outdoors so it has a clear view of the entire sky. If you place the antenna indoors near a window, for example, you will likely not track a sufficient number satellites. With a properly installed antenna the Eclipse OEM board provides a position within approximately 60 sec.

Note: For SBAS tracking it can take up to 5 minutes to receive a full ionospheric map from SBAS. Once it obtains complete ionospheric information, the Eclipse OEM board can compute positions with maximum accuracy.

Communicating with the Eclipse OEM Board

The Eclipse OEM board features three primary serial ports (Port A, Port B, Port C) that you can configure independently from each other. You can configure the ports for any combination of NMEA 0183, binary, and RTCM SC-104 data. The usual data output is limited to NMEA data messages as these are industry standard.

Note: You may use the three serial ports to separate the different data types and output different rates. If the Eclipse OEM board is required to output different data types simultaneously, ensure data logging and the processing software used can correctly parse the different data from a single stream.

Configuring the Eclipse OEM Board

You can configure all aspects of Eclipse OEM board operation through any serial port using proprietary commands. These commands are described in detail in the Hemisphere GPS Technical Reference. You can configure the following:

- Select one of the two firmware applications
- Set communication port baud rates
- Choose which messages to output on the serial ports and the update rate of each message
- Set various receiver operating parameters

For a complete lists of commands and messages refer to the Hemisphere GPS Technical Reference.

To issue commands to the Eclipse OEM board, you will need to connect it to a terminal program such as Microsoft HyperTerminal or either of Hemisphere GPS' software applications (SLXMon or PocketMAX3). See "What is the best software tool to use to communicate with the Eclipse OEM board and configure it?" on page 52 for descriptions of HyperTerminal, SLXMon, and PocketMAX3.

Firmware

The software that runs the Eclipse OEM board is often referred to as firmware since it operates at a low level. You can upgrade the firmware in the field through any serial port as new versions become available.

You can have two firmware applications loaded on the receiver; however, you can only operate one at a time.

The Eclipse OEM board currently ships with the rover RTK application and the base RTK/SBAS application. See the Hemisphere GPS Technical Reference for information on the $JAPP command, which you use to change between the two Eclipse OEM board applications.

Configuring the Data Message Output

The Eclipse OEM board features three primary bi-directional ports (Ports A, B and C) and a differential-only port (Port D). You can configure messages for all ports by sending proprietary commands to the Eclipse OEM board through any port. For a complete lists of commands and messages refer to the Hemisphere GPS Technical Reference.

‘THIS’ Port and the ‘OTHER’ Port

Both Port A and Port B use the phrases “THIS” and “OTHER” when referring to themselves and each other in NMEA messages.

‘THIS’ port is the port you are currently connected to for inputting commands. To output data through the same port (‘THIS’ port) you do not need to specify 'THIS' port. For example, when using Port A to request the GPGGA data message be output at 5 Hz on the same port (Port A), issue the following command:

```
$JASC,GPGGA,5<CR><LF>
```

The ‘OTHER’ port is either Port A or Port B, whichever one you are not using to issue commands. If you are using Port A to issue commands, then Port B is the ‘OTHER’ port, and vice versa. To specify the ‘OTHER’ port for the data output you need to include 'OTHER' in the command. For example, if you use Port A to request the GPGGA data message be output at 5 Hz on Port B, issue the following command:

```
$JASC,GPGGA,5,OTHER<CR><LF>
```

When using Port A or Port B to request message be output on Port C, you must specifically indicate (by name) you want the output on Port C. For example, if you use Port A to request the GPGLL data message be output at 10 Hz on Port C, issue the following command:

```
$JASC,GPGLL,10,PORTC<CR><LF>
```

Saving the Eclipse OEM Board Configuration

Each time you change the Eclipse OEM board’s configuration you may want to save the configuration so you do not have to reconfigure the receiver each time you power it on.

To save the configuration, issue the $JSAVE command to the Eclipse OEM board using a terminal program such as SLXMon or HyperTerminal. The Eclipse OEM board will take approximately five seconds to save the configuration to non-volatile memory and will indicate when the configuration has been saved.

Using Port D for RTCM Input

Port D has been optimized to interface with Hemisphere GPS' SBX-4 beacon board and operates at 9600 baud (8 data bits, no parity and 1 stop bit – 8-N-1).

To configure the Eclipse OEM board to use Port D, issue the following command:

```
$JDIFF,BEACON<CR><LF>
```

To return to using SBAS as the correction source, send the following command to the Eclipse OEM board:

```
$JDIFF,WAAS<CR><LF>
```

For a complete lists of commands and messages refer to the Hemisphere GPS Technical Reference.

Chapter 4: Eclipse OEM Board Development Kit

Introduction

Cable Interface

Environmental Requirements

Power Requirements

Powering the Eclipse Evaluation Kit

Serial Port Interface

Factory Default Parameters

LED Indicators

The Eclipse OEM board development kit is composed of the following:

- Development enclosure
- Development carrier board
- Eclipse II OEM board (P320) or miniEclipse OEM board (P200 or P201)
- Set of adapter boards
- Antenna
- AC power adapter
- Associated cables

This chapter provides detailed information on the interface of the Eclipse OEM board development kit and its specifications.

⚠WARNING: You may open and operate the development kit without the enclosure. Use ESD protection when opening and operating without the enclosure.

Cable Interface

The Eclipse OEM board development kit enclosure provides power, data, and antenna cable interfaces. Figure 4-1 shows the various connections located on the rear panel of the kit enclosure. The Secondary GPS RF connection is for future products.

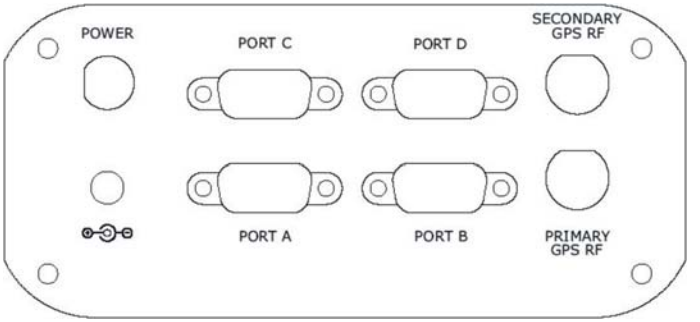


Figure 4-1: Cable interface

Routing and Securing the Cables

When routing Eclipse OEM board development kit cables:

- Avoid running cables in areas of excessive heat
- Keep antenna cables away from corrosive chemicals
- Keep the cable away from rotating machinery
- Be careful not to apply tension to the cable
- Remove unwanted slack from the cable at the opposite end to the antenna
- Do not bend excessively or crimp the extension cable
- Do not run the extension cable through door or window jams
- Do not cause the antenna cable to have any tight loops (less than 30 cm (11.8 in) in circumference)
- Keep the GPS antenna and cable away from radio transmitters, antennas, and cables

⚠WARNING: Improperly installed cables near machinery can be dangerous.

Environmental Requirements

The equipment supplied with the Eclipse OEM board development kit has specific environmental limits you should keep in mind when using and storing the system.

The Eclipse development kit enclosure and Eclipse OEM board are designed to be stored and operated between -40°C and +85°C (-40°F and +185°F). Both the Eclipse OEM board development kit and the Eclipse OEM board are specified to operate in up to 95% non-condensing humidity.

The antenna is designed to operate in an outdoor environment and is waterproof.

Power Requirements

To power the Eclipse OEM board development kit:

- Connect a two-pin DC power cable to a suitable power source

  or

- Connect the one-pin AC adapter to the development kit

The development kit accepts from 5 to 18 VDC and the supplied power should be continuous and clean for best performance (see Table 4-1).

Table 4-1: Power requirements

Input Voltage	Input Current	Input Power
4.5 to 18 VDC	375 mA @ 12 VDC (no antenna)	4.5 W nominal (no antenna)
Note: Values shown are generous; the exact hardware configuration of the Eclipse OEM board you are connecting may draw less power than this.		

WARNING: Connecting more than one source of power at a time can seriously damage the unit and will void the warranty.

Powering the Eclipse OEM Board Development Kit

To power on the Eclipse OEM board development kit:

1. Connect the red wire of the cable's power input to DC positive (+).
2. Connect the black wire of the cable's power input to DC negative (-).

Note: If the Eclipse OEM board does not power on, ensure that the internal power switch on the carrier board is in the "ON" position.

A 1.0 A fast-blow fuse, if equipped and situated in-line of the power input of the power cable, protects the development kit from power surges. The fuse container should remain accessible after installation.

⚠WARNING: Do not operate the Eclipse OEM board development kit with the fuse bypassed. Such a modification will void the product warranty.

The Eclipse OEM board development kit will start when an acceptable voltage is applied.

⚠WARNING: Do not apply a voltage higher than 18 VDC. This will damage the receiver and void the warranty.

Serial Ports

The development kit's four serial ports are RS-232 compatible that you can use to communicate with external data loggers, navigation systems, PCs, and other devices. The serial ports are labeled Port A, Port B, Port C, and Port D.

Ports A, B and/or C may be used for communication. Port D has been designed to communicate with Hemisphere GPS' SBX-4 DGPS beacon receiver to receive DGPS corrections and only operates at 9600 baud with an 8 data bit, no parity and 1 stop bit configuration (8-N-1). Additionally, Ports A, B or C may also receive external DGPS or RTK corrections.

Table 4-2 provides the pin assignments for all four serial ports.

Table 4-2: Serial port pinouts

Port	Pin	SIgnal	Description
A,B,C	2	TXD	NMEA 0183, Hemisphere GPS proprietary binary, RTCM v2.3 (DGPS), RTK v3, and CMR output
	3	RXD	NMEA 0183, Hemisphere GPS proprietary binary, RTCM v2.3 (DGPS), RTK v3, CMR, and CMR+ input
	5	Signal ground	Signal return

Table 4-2: Serial port pinouts (*continued*)

Port	Pin	SIgnal	Description
D	2	TXD	Hemisphere GPS proprietary
	3	RXD	RTCM input
	5	Signal ground	Signal return

Figure 4-2 shows the pinout of each serial port of the development kit.

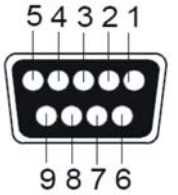


Figure 4-2: DB-9 socket numbering

Note: The baud rate of the development kit's serial ports and the devices they are trying to communicate with must match. Refer to Hemisphere GPS' GPS Technical Reference for information on changing baud rates.

Table 4-3 shows default development kit serial port communication settings.

Table 4-3: Default port settings

Port	Baud Rate	Data Bits	Parity	Stop Bit
A, B or C	19200	8	None	1
D	9600	8	None	1

Note: The Eclipse OEM board uses a CMOS level interface. The Eclipse OEM board development kit carrier board converts from CMOS to RS-232.

LED Indicators

The Eclipse OEM board development kit carrier board features surface-mounted diagnostic LEDs that indicate Eclipse OEM board status. These LEDs are mounted on the edge of the carrier board and are visible through windows in the front panel and provide the functionality described in Table 4-4.

Table 4-4: LED indicators

LED	Color	Function
Power	Red	Power indicator Illuminates when the Eclipse OEM board is powered.
Reset	Green	Reset indicator Illuminates when you press the RESET button and also flashes on powerup. **Note:** Since the RESET button is inside the development kit enclosure, use ESD protection when opening the enclosure.
1 PPS	Blue	Timing signal (1 PPS) Flashes once per second once a GPS signal lock is obtained.
Mark	Red	Mark indicator Illuminates when you press the manual mark button. You must install a jumper at pins 1 and 2 of JP300 (marked “Pushbutton”) to enable the mark button. **Note:** Since the pushbutton is inside the development kit enclosure, use ESD protection when opening the enclosure.
GPS	Yellow	Primary GPS lock indicator Illuminates when the Eclipse OEM board achieves a valid position solution. If this LED continues to flash, it could indicate receiver or antenna hardware failure.
S-GPS	Yellow	Not used (always off)
A-GPS	Yellow	Not used (always off)

Table 4-4: LED indicators (*continued*)

LED	Color	Function
Diff	Yellow	Differential lock indicator Illuminates when the Eclipse OEM board: • Achieves solid SBAS or OmniSTAR lock with better than a 150 Bit Error Rate (BER)—if the SBAS BER is higher than 150, but receiver is still locked, this LED will flash, indicating marginal lock • Receives external DGPS RTCM v2.3 corrections • Receives OmniSTAR VBS corrections • Receives RTK corrections in any acceptable correction format
DGPS	Green	DGPS position indicator Illuminates to indicate high accuracy positioning • For SBAS, DGPS or OmniSTAR VBS positioning solutions, the LED appears as follows: – SOLID if position solution accuracy estimate is below the $JLIMIT command setting • For OmniSTAR HP/XP/HP+/G2 positioning solutions, LED: – SOLID if position accuracy estimate is below the $JLIMIT command setting, and current GGA message position is status 4 or 5 – FLASHES if accuracy is above $JLIMIT setting, or GGA position status is 2 • For RTK positioning solutions, LED: – SOLID if current GGA message position status 4 – FLASHES if current GGA message position status 2 or 5
HDG	Blue	Not used (always off)

Figure 4-3 displays the front panel layout of the Eclipse OEM board development kit enclosure, including the location and labeling of each LED.

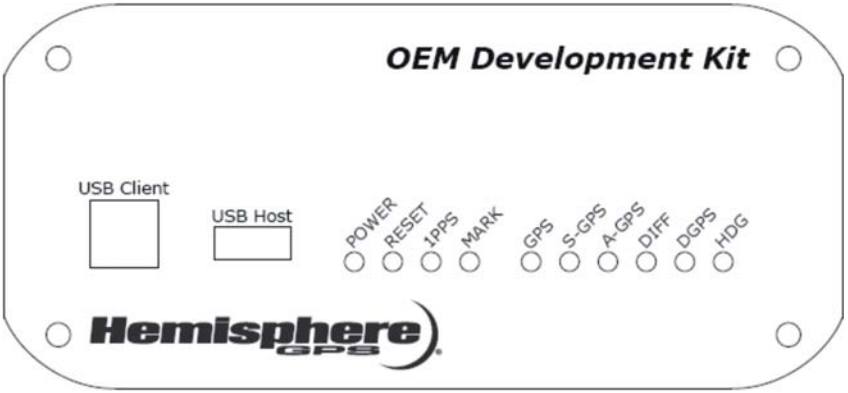


Figure 4-3: Eclipse OEM board development kit front panel

Appendix A: Frequently Asked Questions

General

Integration

Support and Repairs

Troubleshooting

Power, Communication and Configuration

GPS Reception and Performance

SBAS Reception and Performance

External Corrections

Installation

Integration

Do I need to use the 1 PPS and event marker?

No, these are not necessary for Eclipse OEM board operation.

What should I do with the 1 PPS signal if I do not want to use it?

This signal will be strobing at 1 Hz, so it should not be connected.

What should I do with the manual mark input if I am not going to use it?

Do not connect the pin because this signal is active low.

Do I need to use the lock indicators?

No, these are present for applications where it is desirable to have an LED visible to the user. These signals need to be transistor buffered as these lines can only offer 1 mA. Depending on the product and the application, LEDs can be very useful to the end user. These signals are active low.

What do I do with the ARM boot select pin?

This pin is only used for factory operations, so do not connect it.

Do I need to use a shield-can for the Eclipse OEM board?

Not necessarily, however, you may need to if there are RF interference issues, such as if the Eclipse OEM board interferes with other devices. A shield-can would be a good start in terms of investigating the benefit. If you are designing a smart antenna system, one is likely needed. Hemisphere GPS recommends that you always conduct an RF pre-scan when integrating OEM boards.

If my company wishes to integrate this product, what type of engineering resources will I need to do this successfully?

Hemisphere GPS recommends you have sufficient engineering resources with the appropriate skills in and understanding of the following:

- Electronic design (including power supplies and level translation)

- RF implications of working with GPS equipment
- Circuit design and layout
- Mechanical design and layout

What type of assistance can I expect from Hemisphere GPS when integrating the Eclipse OEM board?

Integration of a GPS board has such benefits as:

- Lower system cost
- Improved branding (rather than relabeling an existing product)
- Better control of system design among others

As an integrator, you are responsible for ensuring that the correct resources are in place to technically complete it. Hemisphere GPS will provide reasonable assistance. However, Hemisphere GPS does not have dedicated engineering resources for in-depth integration support. Hemisphere GPS will do its best to provide support as necessary, but you should expect to have reasonable expertise to use this Integrator's Guide.

Support and Repair

How do I solve a problem I cannot isolate?

Hemisphere GPS recommends contacting the dealer first. With their experience with this product, and other products from Hemisphere GPS, they should be able to help isolate a problem. If the issue is beyond the capability or experience of the dealer, you may contact Hemisphere GPS Technical Support. See Technical Support contact information at the bottom of the next page.

Can I contact Hemisphere GPS Technical Support directly regarding technical problems?

Yes, however, Hemisphere GPS recommends speaking to the dealer first as they would be the local support. They may be able to solve the problem quickly, due to their closer location and experience with our equipment.

Troubleshooting

What do I do initially if I have a problem with the operation of the Eclipse OEM board?

Try to isolate the source of the problem. Problems are likely to fall within one of the following categories:

- Power, communication, and configuration
- GPS reception and performance
- Beacon reception and performance
- SBAS reception and performance
- External corrections
- Installation
- Shielding and isolating interference

It is important to review each category in detail in order to eliminate it as a problem.

The questions in the following sections provide information that may help to isolate and solve the problem.

What do I do if I cannot resolve the problem after trying to diagnose it myself?

Contact your dealer to see if they have any information that may help to solve the problem. They may be able to provide some in-person assistance. If this is not viable or does not solve the problem, Hemisphere GPS Technical Support is available during normal business hours. Contact Hemisphere GPS technical support at:

8444 N. 90th St Suite 130
Scottsdale, Arizona 85258
Phone 480.348.9919 Fax 480.348.6370
TechSupport@hemispheregps.com
http://www.hemispheregps.com

Technical support is available from 8:00 AM to 5:00 PM Mountain Standard Time, Monday to Friday.

Power, Communication, and Configuration

My Eclipse OEM board system does not appear to be communicating. What do I do?

This could be one of a few issues:

- Examine the Eclipse OEM board cables and connectors for signs of damage or offset.
- Ensure the Eclipse OEM board system is properly powered with the correct voltage.
- Ensure there is a good connection to the power supply since it is required to terminate the power input with the connector.
- Check the documentation of the receiving device, if not a PC, to ensure the transmit line from the Eclipse OEM board is connected to the receive line of the other device. Also, ensure the signal grounds are connected.
- If the Eclipse OEM board is connected to a custom or special device, ensure the serial connection to it does not have any incompatible signal lines present that prevent proper communication.
- Make sure the baud rate of the Eclipse OEM board matches the other device. The other device must also support an 8 data bit, 1 stop bit, no parity port configuration (8-N-1). Some devices support different settings that may be user configurable. Ensure the settings match.
- Consult the troubleshooting section of the other device's documentation to determine if there may be a problem with the equipment.

Am I able to configure two serial ports with different baud rates?

Yes, all the ports are independent. For example, you may set one port to 4800 and another port to 19200.

Am I able to have the Eclipse OEM board output different NMEA messages through multiple ports?

Yes, different NMEA messages can be sent to the serial ports you choose. These NMEA messages may also be at different update rates.

A high enough baud rate is needed to transmit all the data; otherwise, some data may not be transmitted.

How can I determine the current configuration of the Eclipse OEM board?

The $JSHOW command will request the configuration information from the Eclipse OEM board. The response will be similar to:

```
$>JSHOW,BAUD,19200
$>JSHOW,BIN,1,5.0
$>JSHOW,BAUD,4800,OTHER
$>JSHOW,ASC,GPGGA,1.0,OTHER
$>JSHOW,ASC,GPVTG,1.0,OTHER
$>JSHOW,ASC,GPGSA,1.0,OTHER
```

How can I be sure the configuration will be saved for the subsequent power cycle?

Query the receiver to make sure the current configuration is correct by issuing a $JSHOW command. If not, make the necessary changes and reissue the $JSHOW command. Once the current configuration is acceptable, issue a $JSAVE command and wait for the receiver to indicate the save is complete. Do not power off the receiver until the “save complete” message appears.

How do I change the baud rate of a port from that port?

Connect at the current baud rate of the Eclipse OEM board port and then issue a $JBAUD command to change the port baud rate to the desired rate. Now change the baud rate in your application to the desired rate.

What is the best software tool to use to communicate with the Eclipse OEM board and configure it?

Hemisphere GPS uses three different software applications:

- Microsoft HyperTerminal™ - Available on all Windows® 95, 98, ME, and XP. This tool allows you to configure the Eclipse OEM board by

directly typing commands into the terminal window. The output from the Eclipse OEM board is simultaneously shown. When using HyperTerminal, ensure it is configured to use the correct PC communication port, baud rate and that the local echo feature is on (to see what is being typed).

- SLXMon - Available at www.hemispheregps.com. This application is a very useful tool for graphically viewing tracking performance and position accuracy, and for recording data. It can also configure message output and port settings. SLXMon runs on Windows 95 or higher.
- PocketMax - Available at www.hemispheregps.com. Similar to SLXMon, you can use this application to graphically view tracking performance and position accuracy, record data, and configure message output and port settings. PocketMax version 3 runs on multiple Windows platforms using the Windows .NET framework.

GPS Reception and Performance

How do I know what the Eclipse OEM board is doing?

The Eclipse OEM board supports standard NMEA data messages. The $GPGSV and Bin99 data messages contain satellite tracking and SNR information. If available, the computed position is contained in the $GPGGA message. Additionally, the Eclipse OEM board has surface-mounted status LEDs that indicate receiver status.

Do I have to be careful when using the Eclipse OEM board to ensure it tracks properly?

For best performance, the Eclipse OEM board's antenna must have a clear view of the sky for satellite tracking. The Eclipse OEM board can tolerate a certain amount of signal blockage because redundant satellites are often available. Only four satellites are required for a position; however, the more satellites that are used, the greater the positioning accuracy.

SBAS Reception and Performance

How do I know if the Eclipse OEM board has acquired an SBAS signal?

The Eclipse OEM board outputs the $RD1 message that contains the SBAS Bit Error Rate (BER) for each SBAS channel. The BER value describes the rate of errors received from SBAS. Ideally, this should be zero. However, the Eclipse OEM board performs well up to 150 BER. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.

How do I know if the Eclipse OEM board is offering a differentially-corrected or RTK-corrected position?

The Eclipse OEM board outputs the $GPGGA message as the main positioning data message. This message contains a quality fix value that describes the GPS status. If this value is 2, the position is differentially corrected; if this value is 5, the position is RTK-corrected. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.

How do I select an SBAS satellite?

The Eclipse OEM board, by default, will automatically attempt to track the appropriate SBAS satellites. If multiple satellites are available, the one with the lowest BER value is selected to be used to decode the corrections.

You can manually select which SBAS satellites to track (see the GPS Technical Reference for more information); however, this is not recommended.

Should I be concerned if the Eclipse OEM board is frequently losing lock on SBAS due to obstructions or low satellite elevation angles at my geographic location?

No, provided that the receiver is receiving a full set of corrections relatively often. Using COAST technology, the Eclipse OEM board is able to perform well for up to 40 minutes with old correction data. Similar to DGPS corrections, accuracy degrades over time and distance. To obtain a full set of corrections the Eclipse OEM board antenna receives the ionospheric map

over a period of a few minutes. This is the minimum amount of time required to get a full set of corrections for SBAS operation. After this, the receiver can coast until the next set of corrections have been received.

Accuracy is a function of correction age and current ionospheric activity, which will increase in the coming years.

Do I need a dual frequency antenna for SBAS?

Hemisphere GPS recommends using a dual frequency antenna with the Eclipse OEM board. While some receiver function is possible with an L1-only antenna, full receiver performance will only be realized with a dual frequency antenna.

External Corrections

My Eclipse OEM board system does not appear to be using DGPS or RTK corrections from an external correction source. What could be the problem?

This could be due to a number of factors. To isolate the issue:

- Make sure DGPS corrections are RTCM v2.3 protocol.
- Make sure RTK corrections are either ROX, RTCM v3, CMR, or CMR+ protocol.
- Verify the baud rates used by the Eclipse OEM board match that of the external correction source.
- The external correction should be using an 8 data bit, no parity, 1 stop bit (8-N-1) serial port configuration.
- Inspect the cable connection to ensure there is no damage.
- Check the pinout information for the cables to ensure the transmit line of the external correction source is connected to the receive line of the Eclipse OEM board's serial port and that the signal grounds are connected.
- Make sure the Eclipse OEM board has been set to receive external corrections by issuing the $JDIFF command. See the GPS Technical Reference for more information.

Installation

Does it matter where I mount the Eclipse OEM board's antenna?

Yes, the mounting location must provide a clear view of the sky for satellite tracking. Additionally, the position that it computes is based on the center of the antenna. It should be placed in the location for which the user would like a position. Often antennas are mounted on the centerline of a vehicle or on a pole-mount for georeference.

How will the antenna selection and mounting affect Eclipse OEM board performance?

For best results select a multipath-resistant antenna. Ensure the antenna tracks all the available signals for the receiver.

Mount the antenna:

- With the best possible view of the sky
- In a location with the lowest possible multipath

Using a magnetic mount for the antenna will not affect performance.

Appendix B: Troubleshooting

Use the following checklist to troubleshoot anomalous Eclipse OEM board development kit system operation. Table B-1 provides a problem followed by a list of possible solutions. Refer to Appendix C, “Specifications” if necessary.

Table B-1: Troubleshooting

Problem	Possible solution
Receiver fails to power	• Verify polarity of power leads • Check 1.0 A in-line power cable fuse connection • Check integrity of power cable connections • Check power input voltage • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
No data from the Eclipse OEM board 1. No communication 2. No valid data	• (1) Check receiver power status (this may be done with an ammeter) • (2) Verify Eclipse OEM board is locked to a valid DGPS signal (this can often be done on the receiving device or by using SLXMon) • (2) Verify that Eclipse OEM board is locked to GPS satellites (this can often be done on the receiving device or by using SLXMon) • (2) Check integrity and connectivity of power and data cable connections
Random binary data from Eclipse OEM board	• Verify that the RCTM or the Bin messages are not being accidentally output (send a $JSHOW command) • Verify that the baud rate settings of Eclipse OEM board and remote device match • Potentially, the volume of data requested to be output by the Crescent could be higher than the current baud rate supports. Try using 19200 or higher for the baud rate for all devices

Table B-1: Troubleshooting

Problem	Possible solution
No GPS lock	• Check integrity of antenna cable • Verify antenna's view of the sky • Verify the lock status and signal to noise ratio of GPS satellites (this can often be done on the receiving device or by using SLXMon)
No SBAS	• Check antenna cable integrity • Verify antenna's view of the sky, especially towards that SBAS satellites, south in the northern hemisphere • Verify the bit error rate and lock status of SBAS satellites (this can often be done on the receiving device or by using SLXMon - monitor BER value)
No DGPS position in external RTCM mode	• Verify that the baud rate of the RTCM input port matches the baud rate of the external source • Verify the pinout between the RTCM source and the RTCM input port (the "ground" pin and pinout must be connected, and from the "transmit" from the source must connect to the "receiver" of the RTCM input port).
Non-DGPS output	• Verify Eclipse OEM board SBAS and lock status (or external source is locked)

Appendix C: Specifications

Eclipse II OEM Board Specifications

miniEclipse OEM Board Specifications

Eclipse II OEM Board Specifications

Table C-1 through Table C-6 provide the internal GPS engine operational, serial interface, environmental, power and mechanical specifications of the Eclipse II OEM board.

Table C-1: Eclipse II GNSS sensor specifications

Item	Specification
Receiver type	GNSS L1 & L2 RTK with carrier phase
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS (with subscription code) 12 L2C GPS (with subscription code) 12 L1 GLONASS 12 L2 GLONASS (with subscription code) 3 SBAS or 3 additional L1CA GPS 1 L-Band SBAS
SBAS tracking	3
Update rate	10 Hz standard, 20 Hz available
Timing (1PPS) accuracy	20 ns
Cold start time	< 60 s typical (no almanac or RTC)
Warm start time	< 30 s typical (almanac and RTC)
Hot start time	< 10 s typical (almanac, RTC and position)
Maximum speed	1,850 kph (999 kts)
Maximum altitude	18,288 m (60,000 ft)
Differential options	SBAS, Autonomous, External RTCM, RTK, OmniSTAR (HP/XP/G2)

Table C-2: Eclipse II horizontal accuracy specifications

Item	Description	
	RMS (67%)	2DRMS (95%)
RTK[2,3]	10 mm + 1 ppm	20 mm + 2 ppm
OmniSTAR HP[2,4]	0.1 m	0.2 m
SBAS (WAAS)[2]	0.3 m	0.6 m
Autonomous, no SA[2]	1.2 m	2.5 m

Table C-3: Eclipse II communications specifications

Item	Description
Serial ports	3 full-duplex 3.3 V CMOS
Baud rates	4800 - 115200
Correction I/O protocol	Hemisphere GPS proprietary, RTCM v2.3 (DGPS), RTK v3, CMR, CMR+[1]
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Timing output	1 PPS (HCMOS, active high, rising edge sync, 10 kΩ, 10 pF load)
Event marker input	HCMOS, active low, falling edge sync, 10 kΩ
USB	1 USB Host, 1 USB Device

Table C-4: Eclipse II power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 2.5 W nominal (using L-Band) < 1.9 W nominal (no L-Band)
Current consumption	760 mA nominal (using L-Band) 580 mA nominal (no L-Band)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-5: Eclipse II environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing
Shock and vibration[5]	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational
EMC[5]	CE (IEC 60945 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-6: Eclipse II mechanical specifications

Item	Description
Dimensions	109.2 L x 71.1 W x 16.0 H mm (4.3 L x 2.79 W x 0.63 H in)
Weight	< 71 g (< 2.5 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position, L-Band lock
Power/Data connector	34-pin male header, 0.05 in (1.27 mm) pitch
Antenna connector	MCX, female, straight

[1] Receive only, does not transmit this format.

[2] Depends on multipath environment, number of satellites in view, satellite geometry, and ionospheric activity.

[3] Depends also on baseline length.

[4] Requires a subscription from OmniSTAR.

[5] When integrated in conjunction with the recommended shielding and protection as outlined in this manual.

miniEclipse OEM Board Specifications

Table C-7 through Table C-12 provide the internal GPS engine operational, serial interface, environmental, power and mechanical specifications of the miniEclipse OEM board.

Table C-7: miniEclipse GNSS sensor specifications

Item	Specification
Receiver type	L1 & L2 RTK with carrier phase
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS (with subscription code) 12 L2C GPS (with subscription code) 3 SBAS or 3 additional L1CA GPS
SBAS tracking	3
Update rate	10 Hz standard, 20 Hz available
Timing (1PPS) accuracy	20 ns
Cold start time	< 60 s typical (no almanac or RTC)
Warm start time	< 30 s typical (almanac and RTC)
Hot start time	< 10 s typical (almanac, RTC, and position)
Maximum speed	1,850 kph (999 kts)
Maximum altitude	18,288 m (60,000 ft)
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3

Table C-8: miniEclipse horizontal accuracy specifications

Item	Description	
	RMS (67%)	2DRMS (95%)
RTK[7,8]	10 mm + 1 ppm	20 mm + 2 ppm
SBAS (WAAS)[7]	0.3 m	0.6 m
Autonomous, no SA[7]	1.2 m	2.5 m

Table C-9: miniEclipse communications specifications

Item	Description
Serial ports	3 full-duplex 3.3 V CMOS
Baud rates	4800 - 115200
Correction I/O protocol	Hemisphere GPS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+[6]
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Timing output	1 PPS (HCMOS, active high, rising edge sync, 10 kΩ, 10 pF load)
Event marker input	HCMOS, active low, falling edge sync, 10 kΩ
USB	1 USB Device

Table C-10: miniEclipse power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 1.35 W nominal (L1/L2 RTK) < 1.25 W nominal (L1 SBAS)
Current consumption	410 mA nominal (L1/L2 RTK) 380 mA nominal (L1 SBAS)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-11: miniEclipse environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing
Shock and vibration[9]	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational
EMC[9]	CE (IEC 60945 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-12: miniEclipse mechanical specifications

Item	Description
Dimensions	P200 71.1 L x 40.6 W x 13.4 H mm (2.8 L x 1.6 W x 0.53 H in) P201 72.4 L x 40.6 W x 13.4 H mm (2.85 L x 1.6 W x 0.53 H in)
Weight	< 20 g (< 0.7 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position
Power/Data connector	P200 34-pin male header, 0.05” (1.27 mm) pitch P201 20-pin male header, 0.08” (2 mm) pitch
Antenna connector	MCX, female, straight

[6] Receive only, does not transmit this format.

[7] Depends on multipath environment, number of satellites in view, satellite geometry and ionospheric activity.

[8] Depends also on baseline length.

[9] When integrated in conjunction with the recommended shielding and protection as outlined in this manual.

Appendix D: Resources

Reference Documents

Websites

Reference Documents

National Marine Electronics Association
National Marine Electronics Association (NMEA) Standard for Interfacing Marine Electronic Devices
Version 2.1, October 15, NMEA 1995
7 Riggs Avenue
Severna Park, MD 21146
Tel: +1-410-975-9425
Tel Toll Free: +1-800-808-6632
http://www.nmea.org/

Radio Technical Commission for Maritime Services
RTCM Recommended Standards for Differential NAVSTAR GPS Service
Version 2.2
Developed by Special Committee No. 104, RTCM 1998
1800 N Kent St, Suite 1060
Arlington, VA 22209, USA
Tel: +1-703-527-2000
http://www.rtcm.org/

Radio Technical Commission for Aeronautics
Minimum Operational Performance Standards (MOPS) for Global Positioning System/Wide Area Augmentation System Airborne Equipment
Document RTCA D0-229A, Special Committee No. 159, RTCA 1998
1828 L Street, NW, Suite 805
Washington, D.C. 20036 USA
Tel: +1-202-833-9339
http://www.rtca.org/

ARIC Research Corporation
Interface Control Document, Navstar GPS Space Segment/Navigation User Interfaces
ICD-GPS-200, April 12, 2000
2250 E. Imperial Highway, Suite 450
El Segundo, CA 90245-3509
http://www.navcen.uscg.gov/

Websites

Hemisphere GPS Web Site

The Hemisphere GPS Web site which provides detailed information (including documentation) on all products offered by Hemisphere GPS.

www.hemispheregps.com

FAA WAAS Web Site

The FAA WAAS site offers general information on the WAAS service provided by the U.S. FAAS.

gps.faa.gov

WAAS Broadcast Schedule Web Site

This site provides detailed information relating to the WAAS service broadcast schedule.

http://www.nstb.tc.faa.gov/RT_VerticalProtectionLevel.htm

ESA EGNOS System Test Bed Web Site

This site contains information relating to past performance, real-time performance, and broadcast schedule of EGNOS.

www.egnos-pro.esa.int/index.html

Solar and Ionospheric Activity Web Sites

The following sites are useful in providing details regarding solar and ionospheric activity.

iono.jpl.nasa.gov
www.spaceweather.com

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documentation, PROVIDED THAT: (a) Hemisphere has the right to assume full control over any action, claim, demand or proceeding, (b) Licensee shall promptly notify Hemisphere of any such action, claim, demand, or proceeding, and (c) Licensee shall give Hemisphere such reasonable assistance and tangible material as is reasonably available to Licensee for the defense of the action, claim, demand or proceeding. Licensee shall not settle or compromise any of same for which Hemisphere has agreed to assume responsibility without Hemisphere's prior written consent. Licensee may, at its sole cost and expense, retain separate counsel from the counsel utilized or retained by Hemisphere.

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20. **INDEMNIFICATION**. Except in relation to an infringement action, Licensee shall indemnify and hold Hemisphere harmless from any and all claims, damages, losses, liabilities, costs and expenses (including reasonable fees of lawyers and other professionals) arising out of or in connection with Licensee's use of the Product, whether direct or indirect, including without limiting the foregoing, loss of data, loss of profit or business interruption.
21. **TERMINATION**. Licensee may terminate this Agreement at any time without cause. Hemisphere may terminate this Agreement on 30 days notice to Licensee if Licensee fails to materially comply with each provision of this Agreement unless such default is cured within the 30 days. Any such termination by a party shall be in addition to and without prejudice to such rights and remedies as may be available, including injunction and other equitable remedies. Upon receipt by Licensee of written notice of termination from Hemisphere or termination by Licensee, Licensee shall at the end of any notice period (a) cease using the Software; and (b) return to Hemisphere (or destroy and provide a certificate of a Senior Officer attesting to such destruction) the Software and all related material and any magnetic or optical media provided to Licensee. The provisions of Sections 6), 7), 8), 9), 10), 15), 21), 26) and 27) herein shall survive the expiration or termination of this Agreement for any reason.

22. **EXPORT RESTRICTIONS**. Licensee agrees that Licensee will comply with all export control legislation of Canada, the United States, Australia and any other applicable country's laws and regulations, whether under the Arms Export Control Act, the International Traffic in Arms Regulations, the Export Administration Regulations, the regulations of the United States Departments of Commerce, State, and Treasury, or otherwise as well as the export control legislation of all other countries.
23. **PRODUCT COMPONENTS.** The Product may contain third party components. Those third party components may be subject to additional terms and conditions. Licensee is required to agree to those terms and conditions in order to use the Product.
24. **FORCE MAJEURE EVENT.** Neither party will have the right to claim damages as a result of the other's inability to perform or any delay in performance due to unforeseeable circumstances beyond its reasonable control, such as labor disputes, strikes, lockouts, war, riot, insurrection, epidemic, Internet virus attack, Internet failure, supplier failure, act of God, or governmental action not the fault of the non-performing party.
25. **FORUM FOR DISPUTES**. The parties agree that the courts located in Calgary, Alberta, Canada and the courts of appeal there from will have exclusive jurisdiction to resolve any disputes between Licensee and Hemisphere concerning this Agreement or Licensee's use or inability to use the Software and the parties hereby irrevocably agree to attorn to the jurisdiction of those courts. Notwithstanding the foregoing, either party may apply to any court of competent jurisdiction for injunctive relief.
26. **APPLICABLE LAW**. This Agreement shall be governed by the laws of the Province of Alberta, Canada, exclusive of any of its choice of law and conflicts of law jurisprudence.
27. **CISG.** The United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement or any transaction hereunder.
28. **GENERAL.** This is the entire agreement between Licensee and Hemisphere relating to the Product and Licensee's use of the same, and supersedes all prior, collateral or contemporaneous oral or written representations, warranties or agreements regarding the same. No amendment to or modification of this Agreement will be binding unless in writing and signed by duly authorized representatives of the parties. Any and all terms and conditions set out in any correspondence between the parties or set out in a purchase order which are different from or in addition to the terms and conditions set forth herein, shall have no application and no written notice of same shall be required. In the event that one or more of the provisions of this Agreement is found to be illegal or unenforceable, this Agreement shall not be rendered inoperative but the remaining provisions shall continue in full force and effect.

Warranty Notice

COVERED PRODUCTS: This warranty covers all products manufactured by Hemisphere GPS and purchased by the end purchaser (the "Products"), unless otherwise specifically and expressly agreed in writing by Hemisphere GPS.

LIMITED WARRANTY: Hemisphere GPS warrants solely to the end purchaser of the Products, subject to the exclusions and procedures set forth below, that the Products sold to such end purchaser and its internal components shall be free, under normal use and maintenance, from defects in materials, and workmanship and will substantially conform to Hemisphere GPS's applicable specifications for the Product, for a period of 12 months from delivery of such Product to such end purchaser (the "Warranty Period"). Repairs and replacement components for the Products are warranted, subject to the exclusions and procedures set forth below, to be free, under normal use and maintenance, from defects in material and workmanship, and will substantially conform to Hemisphere GPS's applicable specifications for the Product, for 90 days from performance or delivery, or for the balance of the original Warranty Period, whichever is greater.

EXCLUSION OF ALL OTHER WARRANTIES. The LIMITED WARRANTY shall apply only if the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GPS's relevant User's Manual and Specifications, AND the Product is not modified or misused. The Product is provided "AS IS" and the implied warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE and ALL OTHER WARRANTIES, express, implied or arising by statute, by course of dealing or by trade usage, in connection with the design, sale, installation, service or use of any products or any component thereof, are EXCLUDED from this transaction and shall not apply to the Product. The LIMITED WARRANTY is IN LIEU OF any other warranty, express or implied, including but not limited to, any warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, title, and non-infringement.

LIMITATION OF REMEDIES. The purchaser's EXCLUSIVE REMEDY against Hemisphere GPS shall be, at Hemisphere GPS's option, the repair or replacement of any defective Product or components thereof. The purchaser shall notify Hemisphere GPS or a Hemisphere GPS's approved service center immediately of any defect. Repairs shall be made through a Hemisphere GPS approved service center only. Repair, modification or service of Hemisphere GPS products by any party other than a Hemisphere GPS approved service center shall render this warranty null and void. The remedy in this paragraph shall only be applied in the event that the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GPS's relevant User's Manual and Specifications, AND the Product is not modified or misused. NO OTHER REMEDY (INCLUDING, BUT NOT LIMITED TO, SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS) SHALL BE AVAILABLE TO PURCHASER,

even if Hemisphere GPS has been advised of the possibility of such damages. Without limiting the foregoing, Hemisphere GPS shall not be liable for any damages of any kind resulting from installation, use, quality, performance or accuracy of any Product.

HEMISPHERE IS NOT RESPONSIBLE FOR PURCHASER'S NEGLIGENCE OR UNAUTHORIZED USES OF THE PRODUCT. IN NO EVENT SHALL HEMISPHERE GPS BE IN ANY WAY RESPONSIBLE FOR ANY DAMAGES RESULTING FROM PURCHASER'S OWN NEGLIGENCE, OR FROM OPERATION OF THE PRODUCT IN ANY WAY OTHER THAN AS SPECIFIED IN HEMISPHERE GPS'S RELEVANT USER'S MANUAL AND SPECIFICATIONS. Hemisphere GPS is NOT RESPONSIBLE for defects or performance problems resulting from (1) misuse, abuse, improper installation, neglect of Product; (2) the utilization of the Product with hardware or software products, information, data, systems, interfaces or devices not made, supplied or specified by Hemisphere GPS; (3) the operation of the Product under any specification other than, or in addition to, the specifications set forth in Hemisphere GPS's relevant User's Manual and Specifications; (4) damage caused by accident or natural events, such as lightning (or other electrical discharge) or fresh/salt water immersion of Product; (5) damage occurring in transit; (6) normal wear and tear; or (7) the operation or failure of operation of any satellite-based positioning system or differential correction service; or the availability or performance of any satellite-based positioning signal or differential correction signal.

THE PURCHASER IS RESPONSIBLE FOR OPERATING THE VEHICLE SAFELY. The purchaser is solely responsible for the safe operation of the vehicle used in connection with the Product, and for maintaining proper system control settings. UNSAFE DRIVING OR SYSTEM CONTROL SETTINGS CAN RESULT IN PROPERTY DAMAGE, INJURY, OR DEATH. The purchaser is solely responsible for his/her safety and for the safety of others. The purchaser is solely responsible for maintaining control of the automated steering system at all times. THE PURCHASER IS SOLELY RESPONSIBLE FOR ENSURING THE PRODUCT IS PROPERLY AND CORRECTLY INSTALLED, CONFIGURED, INTERFACED, MAINTAINED, STORED, AND OPERATED IN ACCORDANCE WITH HEMISPHERE GPS'S RELEVANT USER'S MANUAL AND SPECIFICATIONS. Hemisphere GPS does not warrant or guarantee the positioning and navigation precision or accuracy obtained when using Products. Products are not intended for primary navigation or for use in safety of life applications. The potential accuracy of Products as stated in Hemisphere GPS literature and/or Product specifications serves to provide only an estimate of achievable accuracy based on performance specifications provided by the satellite service operator (i.e. US Department of Defense in the case of GPS) and differential correction service provider. Hemisphere GPS reserves the right to modify Products without any obligation to notify, supply or install any improvements or alterations to existing Products.

GOVERNING LAW. This agreement and any disputes relating to, concerning or based upon the Product shall be governed by and interpreted in accordance with the laws of the State of Arizona.

OBTAINING WARRANTY SERVICE. In order to obtain warranty service, the end purchaser must bring the Product to a Hemisphere GPS approved service center along with the end purchaser's proof of purchase. Hemisphere GPS does not warrant claims asserted after the end of the warranty period. For any questions regarding warranty service or to obtain information regarding the location of any of Hemisphere GPS approved service center, contact Hemisphere GPS at the following address:

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